doubling this area and making some increase in pigs we could do without any importation of wheat.

There is much to be said in favour of a potato and pig programme in war, as German experience proves. We ourselves did everything possible to increase the potato area during the war, and though Lord Bledisloe suggests that we vacillated in the matter of pigs, this was inevitable. Every belligerent European nation vacillated in its pig policy, the Germans included. This class of live stock requires extraordinarily close watching; it easily becomes a danger, and in some stages of the war it may be questioned if there was any animal in Europe that served the Allied cause better than the German pig. The management of swine led to violent controversies between the agrarian and the urban population; eventually a pig holocaust was necessary to save the lives of the unfortunate city dwellers. German experience, indeed, does not wholly support Lord Bledisloe's proposition, for even their enormous potato crop—which before the war was three or four times greater than was necessary for human use—played them false. The storage and transport difficulties were immense, there were great losses from frost, and we cannot have forgotten the tales of woe caused by the indigestible kohlrabis which were used to supplement the scanty potato supply. Potatoes may be productive and highly valuable to nations at war, but no crop is more difficult to deal with; the echoes of the German Food Controller's language, when he discussed his potato problems in public, reached us here; and attentive listeners might have discovered that the perplexities presented by the potato excited even our own Food Controllers!

In the course of a great war it might be possible to stimulate potato cultivation to an extent that would reduce corn imports by 25 or 30 per cent., but to achieve the results proposed by Lord Bledisloe it would be necessary to follow the German example and in peace time learn to cultivate and use three or four times as large a quantity as our markets now call for. But it is certain that the farmer would find potato growing for such industries as distilling or starch making very much less profitable than corn growing. Pig feeding would pay better than alcohol or farina, but when the human consumer can barely afford the price necessary to maintain the existing acreage, what prospect is there of a threefold extension of potato growing for pigs?

The present position suggests a decrease rather than an increase in the area of potatoes grown for market. Since the Armistice a change has come over the prospects of the crop. The great rise in the cost of transport and of fuel makes this foodstuff no longer cheap to the urban consumer. In London potatoes are now being sold retail at from 1*s*. 9*d*. to 3*s*. per 14 lb. At 2*s*. the cost of energy would be about 225 Calories per penny; in the 4-lb. loaf at 10*d*. energy can be bought at about 400 Calories per penny, and potatoes must be cooked. There has therefore been a decline in consumption. The large drop in the percentage of the retail price of potatoes and other vegetables now received by the farmer, because of the increase in transport and marketing costs, is a serious matter for the consumer, as well as for the farmer. It means that the market demand has become much less effective than formerly in providing a supply. Until we can greatly reduce the cost of bringing the potato from the farm to the urban consumer the prospect of increasing the area under potatoes as desired by Lord Bledisloe is not encouraging.

Pigs form a more hopeful subject; there is great scope for their increase in peace time. Their place in war is less certain. In any long war we should probably have to ask ourselves whether fat pigs could be allowed to exist alongside a nation of lean people. There would always be advocates for both, but ultimately, as in Germany, the lean people would prevail.

Priestley in America.

Priestley in America, 1794–1804. By Prof. Edgar F. Smith. Pp. v + 173. (Philadelphia: P. Blakiston's Son and Co., 1920.) 1.50 dollars net.

PROF. EDGAR SMITH, of the University of Pennsylvania, in studying the lives of early American chemists, naturally encountered the name of Priestley, who, as is well known, left this country for America in 1794. The odium and insult he had met with as a Dissenter culminated in the Birmingham Riots of 1791, when, to the cry of "Church and King," his house was wrecked and set on fire "with the most savage and determined fury," and the books and apparatus which it had been the business of his life to collect and use were utterly destroyed. What Pitt termed "the effervescence of the public mind" was kept alive by the implacable resentment of the great body of the clergy of the Established Church, aided by the speeches in Parliament of Burke, and by what were then known as "Treasury newspapers," controlled by the political party in power. Priestley's position in this country became so insecure that eventually he determined to leave it and to join his sons, who with certain other persons, mainly Englishmen, were projecting a settlement near Northumberland at the confluence of the north-east and west branches of the Susquehanna. On April 8, 1794, he and his wife sailed from London, and arrived at the Old Battery, New York, on the evening of June 4.

The good ship *Sansom,* under Captain Smith, was not a very speedy craft to require fifty-seven days to cross the Atlantic, and her hundred passengers, with scant provision for their comfort, must have had a weary time of it. Priestley, however, in spite of occasional seasickness, occupied himself, as was his wont, with books. He relates that he read the whole of the Greek Testament and the Hebrew Bible as far as the first Book of Samuel; also Ovid's Metamorphoses, Buchanan's Poems, Erasmus's Dialogues, Peter Pindar's Poems, etc. To amuse himself he tried the temperature of the water at different depths, and made other observations which suggested experiments to be prosecuted whenever he should be able to re-establish his laboratory. To solace him he had received sundry parting gifts, among them "an elegant silver inkstand" from "three young gentlemen of the University of Cambridge," who regretted that such an "expression of their esteem should be occasioned by the ingratitude of their country." Also a characteristically florid and highly rhetorical valedictory address from the Society of United Irishmen of Dublin, enjoining him to pray for the patriots who, like him, were about to cross the bleak Ocean to a barbarous land—victims of "purblind statesmen" like Mr. Pitt.

Priestley was well received in America. His fame as a man of science had preceded him, and his well-known warm friendship for Franklin was in his favour. Indeed, it was generally acknowledged that this friendship reacted powerfully upon Priestley's work as a political thinker and as a natural philosopher. The *American Daily Advertiser*, in an editorial article of welcome, declared that it afforded

> "the most sincere gratification to every well-wisher to the rights of man, that the United States of America, the land of freedom and independence, has become the asylum of the greatest characters of the present age who have been persecuted in Europe, merely because they have defended the rights of the enslaved nations. . . . The citizens of United America know well the honourable distinction that is due to virtue and talents; and while they cherish in their hearts the memory of Dr. Franklin, as a philosopher, they will be proud to rank among the list of their illustrious fellow-citizens, the name of Dr. Priestley."

For some days after their arrival the travel-worn voyagers were busily occupied in receiving visits from the principal inhabitants of New York and in replying to addresses of welcome from corporate bodies and societies in the State. These addresses, together with Priestley's replies, occupy a considerable section of Prof. Smith's book. The general character of the addresses is very similar. There is much about the arm of tyranny, corrupt Governments, venal Courts, an imperious and uncharitable priesthood, etc., all contrasted with liberty and equality and the system of beauty and excellence and "of virtuous simplicity" which characterised the happy Republican Government of America, where Reason had triumphed over the artificial distinctions of European policy and bigotry, and "where Providence had unfolded a scene as new as it is august, as felicitating as it is unexampled." Priestley's replies were couched, as might be expected, in less turgid rhetoric; but it is obvious from their terms that he was much affected by and grateful for the warmth of his welcome.

Amidst the general chorus there was, however, one dissonant note. It came from William Cobbett, and was sounded with characteristic violence. His pamphlet, "Observations on the Emigration of a Martyr to the Cause of Liberty," was a scurrilous attack on Priestley. It was the first of a series of lampoons signed "Peter Porcupine," mainly directed against American statesmen, which resulted in convictions for libel, and Cobbett was forced to leave the country.

After a fortnight's stay in New York Priestley moved to Philadelphia, then the seat of Government, where he was welcomed by the American Philosophical Society, which had been founded in 1727 by his friend Franklin. But Philadelphia had few attractions for him. He found it "unpleasant, unhealthy and intolerably expensive"—"only a place for business and to get money in," and he soon moved to Northumberland, where, with the exception of an occasional visit to Philadelphia either to lecture or to preach, he remained to the end of his days. He was invited to accept a professorship of chemistry in the Medical College of Philadelphia, but as this would require his residence for at least four months of the year in that city he declined it.

At Northumberland he occupied himself in helping his youngest son, Henry, to clear the land, in planning his new house, working at his "Church History," and occasional experimenting. Towards the end of 1795 he sent papers to the American Philosophical Society on the analysis of atmospherical air and on the generation of air from water, which filled twenty quarto pages of vol. 4 of the Transactions of that learned body. These papers have little or no scientific value: their main interest consists in the fact that they were the first contributions he made in America to the literature of chemistry. As was the case with all his papers, they were written in the language of phlogistonism, and Stahl's doctrine was already on the wane, even in Young America. In the same year Priestley lost his favourite son, Henry. It was a bitter blow, from which neither he nor his wife ever wholly recovered. Indeed, from this time Mrs. Priestley's health steadily declined, and nine months later she, too, passed away. She was a woman of remarkable fortitude and strength of character, generous and affectionate, and a true helpmate to her husband. Her great-granddaughter, Madame Belloc, has paid a worthy tribute to her memory.

There were now rumours that Priestley intended to return to England, or at least to Europe, and he actually contemplated taking up his residence in France. It is doubtful whether he was ever wholly reconciled to his life in America. He said himself: "Here, though I am as happy as this country can make me . . . I do not feel as I did in England." He had occasional fits of depression—all the more remarkable for a man of his usually serene and equable temperament. He felt, too, that his "character as a philosopher was under a cloud." Phlogistonism was a lost cause, and, in spite of his efforts to keep it alive, he understood quite well, as Prof. Smith says, that "the entire chemical world was against him." Experimenting was now irksome to him, and, as he states, he became "quite averse to having his hands so much in water"; moreover, Priestley was an eminently sociable being, and he had little congenial society in Northumberland.

He simply hungered for letters from his friends in England. He wrote to Lindsey: "I cannot express what I feel when I receive and read your letters. I generally shed many tears over them." He turned more and more to theology, interested himself in the politics of the country, although he took no active part in them, wrote on public education and on the organisation of the college which President Jefferson contemplated for the State of Virginia. He was still, at times, drawn to science, for he had fitted up a small laboratory adjacent to his house, and the experimental work he did in it was embodied in "Six Chemical Essays," which were communicated to the American Philosophical Society and are printed in their Transactions. The essays consist of miscellaneous observations of no special scientific value. Indeed, it must be admitted that Priestley's chemical work in America added little to his scientific reputation. The laboratory, a small wooden building, remains much as he left it. It will shortly be removed to the Campus of Pennsylvania State College, where it will be preserved as a memorial to the famous chemist. Much of the apparatus is, however, in the possession of Dickinson College (Pa.). It is to be hoped that it will be ultimately deposited in the laboratory—surely the most fitting place for it. It would add greatly to the historic interest of the memorial.

It was on the piazza of Priestley's dwelling-house that the men who assembled on August 1, 1874, to celebrate the centenary of the discovery of oxygen, then and there founded the American Chemical Society.

The opening year of the new century found Priestley suffering from the infirmities of age. He was now nearly toothless, which, together with his incurable stutter, added to his difficulties of speaking. Moreover, his sense of hearing became impaired, and he was obliged to use an ear-trumpet. He was, however, thankful that his eyes did not fail him. During one of his visits to Philadelphia he had an attack of pleurisy, and for a time his life was in danger, while occasionally he suffered from ague. He said of himself:

> "Tho' I was never robust, I hardly knew what sickness was before my seizure in Philadelphia, but the old building has since that had so many shocks, that I am apprehensive it will ere long give way. But I have abundant reason to be satisfied, and shall retire from life *conviva satur.*"

His apprehensions were soon to be realised. In the spring of 1803 he had a dangerous fall, and strained the muscles of the thigh, and for a time was obliged to use crutches. He suffered from the cold of the winter of 1804, and again contracted pleurisy, from which he died on February 6, in the seventy-first year of his age, breathing his last in the act of correcting a proof-sheet.

Prof. Edgar Smith gives the fullest and best account of Priestley's life in America which has yet appeared. He seems to have tapped every available source of information, and has had access to many letters and memoranda hitherto unpublished. The book serves to complete the life-history of one who has been styled a "hero and type of the intellectual energy of the eighteenth century," and whose name, in spite of his errors and his misguided loyalty to a false philosophy, is imperishably fixed in the annals of science.

T. E. THORPE.

The Actinomycetes.

Morphologie und Biologie der Strahlenpilze. (Actinomyceten.) By Prof. Rudolf Lieske. Pp. ix + 292 + Tafel 4. (Leipzig: Gebrüder Borntraeger, 1921.) 108 marks.

THIS volume by Prof. Rudolf Lieske, of the Botanical Institute at Heidelberg, on the morphology and biology of the Actinomycetes, forms a valuable addition to the literature of this subject. In a general introductory chapter there are an account of the occurrence of Actinomycetes in Nature and an annotated list of recorded species, references being given to original descriptions. This section also contains a discussion of the relation of Actinomycetes to Bacteria, Mycobacteria, Hyphomycetes, etc., the conclusion—from which many of us would dissent—being that the former are a primitive stem from which the latter have been derived.

The second section, dealing with the morphology of Actinomycetes, suffers from the lack of a thorough comparative study of growth forms under different standardised conditions. Still, Prof. Lieske approaches his subject with a more experimental and dynamic attitude of mind than that of a recent American investigator of Actinomycete morphology, and his results are correspondingly enlightened. In the study of higher organisms there has been developed a physiological anatomy; in the study of lower organisms perhaps our greatest need is a physiological morphology. When we abandon teleology and learn to interpret shape and structure in terms of physico-chemical relationships we shall begin to build a true micro-organismal morphology. The Actinomycetes would be a good group on which to commence. Prof. Lieske finds that they possess a true mycelium with typical monopodial branching, and "Luftsporen" are formed endogenously. The questions of cell nuclei and a possible primitive sexuality are left open, but it is disappointing to find "involution forms" dismissed as merely teratological growths—surely mycologists and bacteriologists have too long been content with this futile label.

The third section, dealing with the physiology of Actinomycetes, is perhaps the best, but again suffers from a too timid and unimaginative viewpoint. There is the usual consideration of the relation of the organisms to carbon, nitrogen, etc. —all useful data; but the very important enzymic relations of Actinomycetes, their antagonistic or additive reactions with other micro-organisms and their function in the soil economy, the very interesting pigments produced—these and other vital issues are treated too summarily. The fourth section deals with animal and human diseases such as "Madura foot," "lumpy jaw," etc. There is also a useful summary of methods of staining and the preparation of specimens. The last section of eight pages concerns the Actinomycetes in their relation to higher plants, and is merely a very inadequate account of potato scab and the root nodules of the alder. The work closes with a bibliography of 378 titles, of which 322 are German, while important works such as Poncet's comprehensive monograph are omitted.

The most serious difficulty in the study of Actinomycetes is the specific determination of the organisms isolated, and here Prof. Lieske's work gives no help. It needs to be supplemented by Drechsler's beautiful drawings in the *Botanical Gazette* and Waksman's cultural data in the *Journal of Bacteriology*. The book is finely produced with 114 text illustrations and four beautifully coloured plates, and in spite of its defects is a very valuable addition indeed to the literature of this important and obscure group of organisms.

W. B. BRIERLEY.

Emin Pasha's Last Collections.

Die Tagebücher von Dr. Emin Pascha. Herausgegeben mit Unterstützung des Hamburgischen Staates und der Hamburgischen Wissenschaftlichen Stiftung von Dr. Franz Stuhlmann. Band 6, *Zoologische Aufzeichnungen Emin's und seine Briefe an Dr. G. Hartlaub bearbeitet von Prof. Dr. H. Schubotz.* Pp. viii + 301. (Hamburg und Braunschweig: Georg Westermann, 1921.) 200 marks.

THE volume under review gives us notes, mainly ornithological, on the last collections made by this remarkable German-Jewish explorer in the equatorial Egyptian Sudan, including the south-eastern part of the Bahr-al-ghazal region, the Latuka-Lango district, and the north-west coast of the Albert Nyanza; but the author treats also of birds and mammals which have come under his observation in the countries between the south shores of the Victoria Lake and